

What is claimed is:

1. An apparatus for treating wastes, said apparatus comprising:

a fluidized bed reactor for partially combusting the wastes at a temperature of from 450°C to 650°C, thereby forming a gaseous material and carbonous material, while crushing the carbonous material by a fluidized bed in said fluidized bed reactor to thereby form char, said fluidized bed reactor having an outlet for discharge of the gaseous material and the char;

a combustor, separate from said fluidized bed reactor and operable at a temperature sufficient to melt an ash content of the char, for receiving the gaseous material and the char from said outlet of said fluidized bed reactor and for gasifying the gaseous material and the char to form synthesis gas, while melting the ash content to thereby form molten slag, said combustor having an outlet for discharge of the molten slag;

a cooler to cool the synthesis gas to form cooled synthesis gas;

a CO converter to receive the cooled synthesis gas and to perform a CO-conversion reaction to produce H₂ and CO₂; and

a separator to separate said H₂ from the CO₂.

2. An apparatus claimed in claim 1, wherein said further comprising fluidized bed reactor is operable to form a revolving flow of fluidized medium in such a manner that the fluidized medium descends in a first region of said fluidized bed reactor, ascends in a second region of said fluidized bed reactor, moves from said first region toward said second region in a lower portion of said fluidized bed reactor, and moves from said second region toward said first region in an upper portion of said fluidized bed reactor.

3. An apparatus as claimed in claim 1, wherein said combustor is operable to form the gaseous material and char into a swirling flow in said combustor.

4. An apparatus as claimed in claim 1, further comprising structure to introduce oxygen-containing gas and steam as a gasifying agent into at least one of said fluidized bed reactor and said combustor.

capable

5. An apparatus as claimed in claim 1, further comprising a separator to separate air into oxygen and nitrogen.

6. An apparatus as claimed in claim 5, further comprising a line to pass the oxygen as a gasifying agent to at least one of said fluidized bed reactor and said combustor.

easy

7. An apparatus as claimed in claim 5, further comprising a synthesizer to combine the nitrogen with the H_2 for synthesis of ammonia.

8. An apparatus as claimed in claim 1, further comprising a supply of oxygen enriched air as a gasifying agent to at least one of said fluidized bed reactor and said combustor.

9. An apparatus claimed in claim 8, further comprising a control of the oxygen concentration of the oxygen enriched air so that a ratio of hydrogen gas to nitrogen gas obtained after the CO conversion reaction is 3:1.

apparatus
has means
for
controlling
gas
concentration

10. An apparatus as claimed in claim 1, further comprising a supply of oxygen-containing gas as a gasifying agent to said fluidized bed reactor and said combustor, such that oxygen concentration of the oxygen-containing gas is controlled to be from 0.1 to 0.6 of the theoretical amount of oxygen required for combustion of the wastes.

capable of

11. An apparatus as claimed in claim 10, wherein said supply is operable such that the oxygen concentration of the oxygen-containing gas introduced into said fluidized bed reactor is controlled to be from 0.1 to 0.3 of the theoretical amount of oxygen required for combustion of the wastes.

capable

12. An apparatus as claimed in claim 13, further comprising at least one of sand, alumina, limestone and dolomite as a fluidized medium of said fluidized bed reactor.

13. An apparatus as claimed in claim 1, wherein the partial combusting in said fluidized bed reactor is achieved by primary and secondary combustions, and the gasifying in said combustor is achieved by a tertiary combustion.

Capable

14. An apparatus as claimed in claim 1, operable at a pressure of 10 to 40 atmospheres.

Capable

15. An apparatus as claimed in claim 1, operable at a pressure of 30 to 40 atmospheres.

16. An apparatus as claimed in claim 1, wherein said temperature sufficient to melt said ash content of said char is at least 1300°C, and wherein said cooler comprises a quencher for removing the molten slag from said combustor and quenching the synthesis gas and molten slag by introducing the synthesis gas and molten slag directly into a liquid bath in a quenching chamber of said quencher.

17. An apparatus as claimed in claim 16, wherein said combustor includes a gasifying chamber and quenching chamber, the gasifying the gaseous material and the char is conducted in said gasifying chamber, and the quenching is conducted in said quenching chamber.

18. An apparatus as claimed in claim 16, wherein the quenching generates steam.

Capable

19. An apparatus as claimed in claim 16, wherein said fluidized bed reactor is operable to form a revolving flow of fluidized medium in such a manner that the fluidized medium descends in a first region of said fluidized bed reactor, ascends in a second region of said fluidized bed reactor, moves from said first region toward said second region in a lower portion of said fluidized bed reactor, and moves from said second region toward said first region in an upper portion of said fluidized bed reactor.

20. An apparatus as claimed in claim 16, wherein said combustor is operable to form the gaseous material and char into a swirling flow.

21. An apparatus as claimed in claim 16, further comprising structure to introducing oxygen-containing gas and steam as a gasifying agent into at least one of said fluidized bed reactor and said combustor.

22. An apparatus as claimed in claim 16, further comprising a separator to separate air into oxygen and nitrogen.

23. An apparatus as claimed in claim 22, further comprising a line to pass oxygen as a gasifying agent to at least one of said fluidized bed reactor and said combustor.

24. An apparatus as claimed in claim 22, further comprising a synthesizer to combine the nitrogen with the H_2 for synthesis of ammonia.

25. An apparatus as claimed in claim 16, further comprising a supply of oxygen enriched air as a gasifying agent to at least one of said fluidized bed reactor and said combustor.

26. An apparatus as claimed in claim 25, further comprising a controlling of the oxygen concentration of the oxygen enriched air so that a ratio of hydrogen gas to nitrogen gas obtained after CO conversion reaction is 3:1.

27. An apparatus as claimed in claim 16, further comprising a supply of an oxygen-containing gas as a gasifying agent to said fluidized bed reactor and said combustor, such that oxygen concentration of the oxygen-containing gas is controlled to be from 0.1 to 0.6 of the theoretical amount of oxygen required for combustion of the wastes.

28. An apparatus as claimed in claim 27, wherein said supply is operable such that the

oxygen concentration of the oxygen-containing gas introduced into said fluidized bed reactor is controlled to be from 0.1 to 0.3 of the theoretical amount of oxygen required for combustion of the wastes.

29. An apparatus as claimed in claim 16, further comprising at least one material selected from the group consisting of sand, alumina, limestone and dolomite as a fluidized medium of said fluidized bed reactor.

30. An apparatus as claimed in claim 16, wherein the partial combusting in said fluidized bed reactor is achieved by primary and secondary combustions, and the gasifying in said combustor is achieved by a tertiary combustion.

31. An apparatus as claimed in claim 16, operable at a pressure of 10 to 40 atmospheres.

32. An apparatus as claimed in claim 16, operable at a pressure of 30 to 40 atmospheres.